



# Analysis of price, cost price and efficiency of organic rice production from 2015 to 2018 in the Mekong Delta, Vietnam

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## General Note



Article is recommended to print as color version in recycled paper. *Save Trees, Save Nature.*

## ABSTRACT

From 2015 to 2018, the group of scientists implementing organic projects from the Institute of Agricultural Sciences for Southern Vietnam (IAS) in collaborating with Department of Science and Technology of Tra Vinh province; Oxfam Vietnam's Right to Food and GRAISEA 2 Projects have successfully built organic rice production models in rice-shrimp region in the Mekong Delta provinces. Analysis of model building results shows that organic rice model productivity is still lower than inorganic rice (averaging about 4.744 T / ha, compared to 5.32 T / ha) but tends to increasing. The selling price of farmers' organic rice is positively correlated with the profit of organic rice production. In the first 3 years, businesses have set a very high purchase prices, 8700 VND / kg in 2015, 10325 VND / kg in 2016 and highest with 10890 VND / kg in 2017. Since 2017, the purchase price of organic rice has decreased markedly. In My Xuyen was 7500 VND / kg, in An Minh were 7419 VND / kg and in An Minh, 2018 was 7750 VND / kg. Meanwhile, the price of inorganic rice price fluctuated from 6480 VND / kg, in 2015 to 7200 VND / kg in 2018, the highest is 7562 VND / kg in 2017 in Chau Thanh. The cost prices of organic rice was lowest in An Minh district in 2018 with only 2555 VND / kg compared to inorganic of 2502

VND / kg. See as the cost prices of organic rice here is nearly equal to the cost prices of inorganic rice with the same conditions of variety, season and production location. This is a remarkable point to withdraw the experience for production investment in order to reduce costs and increase productivity to increase economic efficiency for farmers and businesses involved in value chain linkage. Although the profitability of organic rice production in later years has decreased (25980000 million VND / ha in 2017, to 20140000 VND / ha in 2018), the organic rice model still tends to develop widely in region. This proves the effectiveness of the model by the participation of the State and the authorities at all levels and businesses, and at the same time confirms the transformation consciousness and cultivation behavior towards the sustainable production of the farmers.

**Keywords:** shrimp-rice farming model, Mekong Delta, Organic farming

## 1. INTRODUCTION

According to the Vietnam Association of Seafood Exporters and Producers (vasep.com.vn, January 7, 2019), citing the KHPT newspaper that the shrimp-rice farming model has a relatively fast growth rate in the Mekong Delta. If in 2000, the area of shrimp-rice farming in the whole region was only 71,000 ha, then 15 years later, the area increased to 175,000 ha, accounting for 30.5% of the total area of tiger shrimp farming in the whole region and the output reached 75,000 ton. The provinces with large areas of shrimp-rice farming include: Kien Giang, Ca Mau, Bac Lieu, Soc Trang. Average yield of shrimp - rice reaches about 300-500 kg / ha of shrimp and 4-7 tons of rice. The average production cost is 30-35 million VND / ha, the average interest is 35-50 million VND / ha / year. [1]

According to experts, saline intrusion and climate change scenarios, sea level rise, will lead to many areas of saline intrusion, potentially expand shrimp farming area (or rice-shrimp, the author statement) or forced to switch to shrimp farming to adapt. Therefore, the brackish shrimp farming area in the coming years is likely to expand to 800,000 - 1 million hectares, mainly concentrated in the Mekong Delta. Brackish shrimp, especially tiger shrimp (native species) always have high commercial value, stable market and great competitiveness. [2]

The author Nguyen cong Thanh [3] reported that the rice-shrimp system has the characteristics of mutual benefits as follows:

- Taking advantage of residual organic matter after the shrimp cultivation to supplement nutrition for the rice crops,
- Shrimp/aquaculture raising after rice was used artificial and natural feeds from plankton in the wetland environment and developed well due to the decomposition of crop roots,
- A rice-shrimp farming creates ecological balance and environmental safety condition for crops and livestock (aquaculture),
- Limiting pests for both rice and livestock thank to the rotation to cut the pest's source,
- Increase resolution and leaching toxic elements by rotating modes of ecosystems (saltwater, freshwater exchange, and rice root activity and the movement of livestock in the field),
- Reduce production costs by limiting the use of fertilizers due to persistent organic material residues in the soil,
- Limit or no use of pesticides by cutting off sources of pests by rotation, no tillage, no weeding or do very little because no weeds in the flooded fields before planting rice, thus reducing environmental pollution,

\* As a basis condition for the creation of delicious, organic cleaning products to serve for human health, creating important commodities for export, and increasing income for farmers and businesses participating in the linkage from production to consumption.

Organic farming is rapidly gaining recognition worldwide as a promising means to offer healthier food and to ensure environmental sustainability. Currently, organic produce including organic rice is in huge demand owing to its potential to fetch premium price in the global market. Despite the fact that rice performs well under organic production system, a set of constraints including nitrogen stress at critical growth stages, unavailability of rapidly mineralizable organic amendments, lack of appropriate varieties and intense crop-weed competition pose major challenges to realize the potential yield [9].

Since 2015, scientists from the Institute of Agricultural Sciences for Southern Vietnam (IAS) in collaboration with the Department of Science and Technology of Tra Vinh province have begun studying the implementation of organic rice model in Chau Thanh district, Tra Vinh province (fig. 1). Initially, the project team has faced with many difficulties and challenges such as no production process, serious shortage of fertilizers and organic pesticides, farmers have not trusted the effectiveness of the model, and do not believe in the solidity of the link (Enterprise-Farmers) due to previous failures because the business side does not keep the credibility or because the farmers break the linkage contract.



**Figure 1** Farmers in Chau Thanh district, Tra Vinh province were thinking about the results of organic farming conversion in their fields (Trà Vinh, 2016)

However, due to the efforts and enthusiasm of the project team and social responsibility (CSR) of participating enterprises (such as Viorsa, Ecotiger ...), the first year results despite lower organic rice yield compared to inorganic, but thank to the price of buying company is much higher (25.5%) than the price of inorganic one, so it leads to the income of organic model is much higher. From the first year results achieved, and thanks to the promotion of Oxfam projects in Vietnam such as Right To Food (2017-2018), and policies to encourage organic agriculture of The Government as Decree No. 109/2018 / ND-CP on organic agriculture issued by the Government, effective from October 15, 2016, has stipulated many new policies to encourage organic agricultural development in Vietnam. [6] Derived from government policy, many provinces also have policies to develop organic agriculture of their own. For example, Kien Giang province: In the field of rice production, the province continues to review and adjust the planning of high quality rice cultivation of 100,000 ha in the western districts of Hau river and Long Xuyen quadrangle, adding more areas of shrimp-rice rotation in U Minh Thuong district, Investing in complete irrigation, electricity, pumping stations, mechanizing production stages and applying high technology into the production process. For U Minh Thuong region, the province built special rice-shrimp area orienting to organic cultivation [7]. The models of organic rice are continuing to expand and develop in many provinces in the Mekong Delta. Following are some data analyzing production profit, selling price, and cost prices of organic rice in the models from 2015-2018 in the Mekong Delta.

## 2. RESEARCH METHODOLOGY

This paper taking integrated organic rice and shrimp farming and value chain linkage between farmers and companies into consideration for research and development and suggesting suitable solutions in organic agriculture development. The authors have synthesized the results of building organic rice production models in large scale at different locations and years from 2015 to 2018.

Building organic rice production model is based on principles for organic production. According to IFOAM (The International Federation of Organic Agriculture Movement) there are 04 principles of organic agriculture (OA), approved by IFOAM from 25 September, 2005 [4]:

- The principle of health: This principle points out that the health of individuals and communities cannot be separated from the health of ecosystems - healthy soils produce healthy crops that foster the health of animals and people.

- The principle of ecology: This principle roots Organic Agriculture within living ecological systems. It states that production is to be based on ecological processes, and recycling. Nourishment and well-being are achieved through the ecology of the specific production environment. For example, in the case of crops this is the living soil; for animals it is the farm ecosystem; for fish and marine organisms, the aquatic environment...
- The principle of fairness: Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings.
- The principle of care: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Science is necessary to ensure that Organic Agriculture is healthy, safe and ecologically sound. However, scientific knowledge alone is not sufficient. Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions, tested by time.

Standards of organic farming: According to the USDA [5], OA produces products using the methods of conservation of the environment and avoids the use of synthetic inputs such as chemical fertilizer and pesticides, and antibiotic. The USDA organic standards will specify the inputs used for crop and OA for pets. USDA defined organic standards in particular. These standards include products from farm to eating table and even the quality of soil, water, pest management, agricultural practices, animal husbandry and processing.

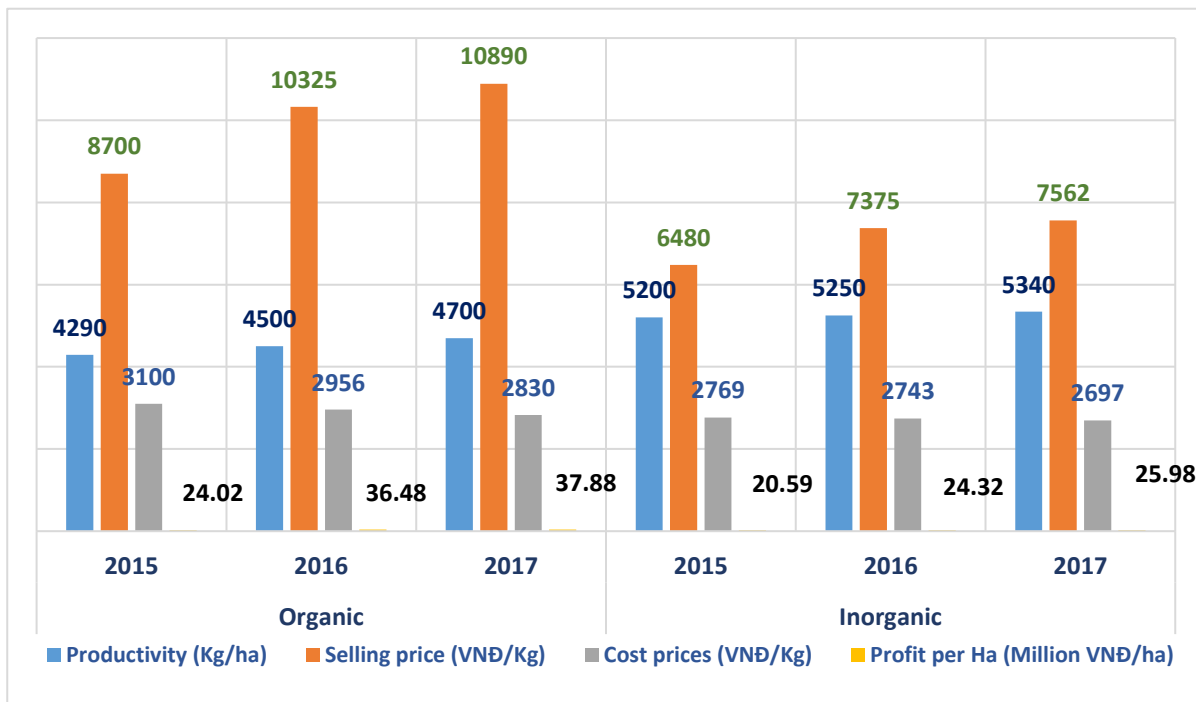
The authors selected the main parameters for analysis such as: Total cost (VND / ha); Productivity (Kg / ha); Selling price (VND / Kg); Total income (VND / ha); Profit (VND / ha); Cost prices (VND / Kg); Profit / kg of rice (VND / kg) and capital efficiency or Marginal Benefit Cost Ratio (MBCR) to calculate and include in report tables and design graphs to interpret the analysis of the model results. At the same time, it is compared with the related studies of authors in similar organic agricultural production countries.

### 3. RESULTS AND DISCUSSION

#### Results of 3 years of research to build an organic rice production model linking value chains in Chau Thanh district, Tra Vinh province

**Table 1** Economic efficiency per Ha of organic rice model in Chau Thanh, Tra Vinh in 2015, 2016 and 2017

Comparative indicators	2015		2016		2017	
	Organic model	Inorganic production	Organic model	Inorganic production	Organic model	Inorganic production
Total cost (VND / ha)	13,300,000	14,400,000	13,300,000	14,400,000	13,300,000	14,400,000
Productivity (Kg / ha)	4,290	5,200	4,500	5,250	4,700	5,340
Selling price (VND / Kg)	8,700	6,480	10,325	7,375	10,890	7,562
Total income (VND / ha)	37,323,000	34,992,000	49,782,000	38,718,750	51,183,000	40,381,080
Profit per ha (VND / ha)	24,023,000	20,592,000	36,481,000	24,318,750	37,883,000	25,981,080
Cost prices (VND / Kg)	3,100	2,769	2,956	2,743	2,830	2,697
Profit per kg of rice (VND / kg)	5,600	3,960	8,107	4,632	8,060	4,554
Capital efficiency	1.80	1.40	2.74	1.70	2.85	1.80



**Graph 1** Economic efficiency per ha of organic rice model in Chau Thanh district, Tra Vinh province from 2015 - 2017

The data in Table 1 and Graph 1 show:

*In terms of productivity:* In 3 years of project implementation, since 2015, organic rice productivity and the control (inorganic rice) were tended to increase each year. Yield of organic rice was 4.29 T / ha, 4.5 T / ha and 4.7 T / ha (respectively for 2015, 2016 and 2017); compared with the control was 5.2 T / ha, 5.25 T / ha and 5.34 T / ha (respectively for 2015, 2016 and 2017).

*For selling price:* Since the contract between enterprises and farmers had encouraged for certified organic rice so that the selling price was increased each year. It was 8,700VND / kg, 10,325 VND / kg and 10,890 VND / kg for 2015, 2016 and 2017 respectively. Meanwhile, the selling price of inorganic rice was fluctuated with the annual market price with 6,480 VND / kg, 7,375 VND / kg and 7,562 VND / kg for 2015, 2016 and 2017 respectively.

*Cost prices per kg of rice:* For organic rice, the cost prices per kg of rice was reduced year by year because when farmers had got acquainted with new production techniques, farmers sought to lower costs (reduce costs). The cost prices was 3,100 VND / kg, 2,956 VND / kg and 2,830 VND / kg compared to 2,769 VND / kg, 2,743 and 2,697 VND / kg of inorganic rice for 2015, 2016 and 2017 respectively. The cost prices for inorganic rice was lower than the cost prices of organic rice due to the high cost of fertilizer, hand weeding and lower yields in the beginning years. These are needed for attention to improving the efficiency of organic rice production for next years.

*For profit per Ha:* Due to the small value, so there is no column of profit showing on the Graph. The profit of organic rice production was 24,020,000 VND / ha, 36,480,000 VND / ha and 37,880,000 VND / ha for 2015, 2016 and 2017 respectively. Meanwhile, profit in inorganic farming was not much at all: 20,590,000, 24,320,000 and 25,980,000 VND / ha for 2015, 2016 and 2017 respectively.



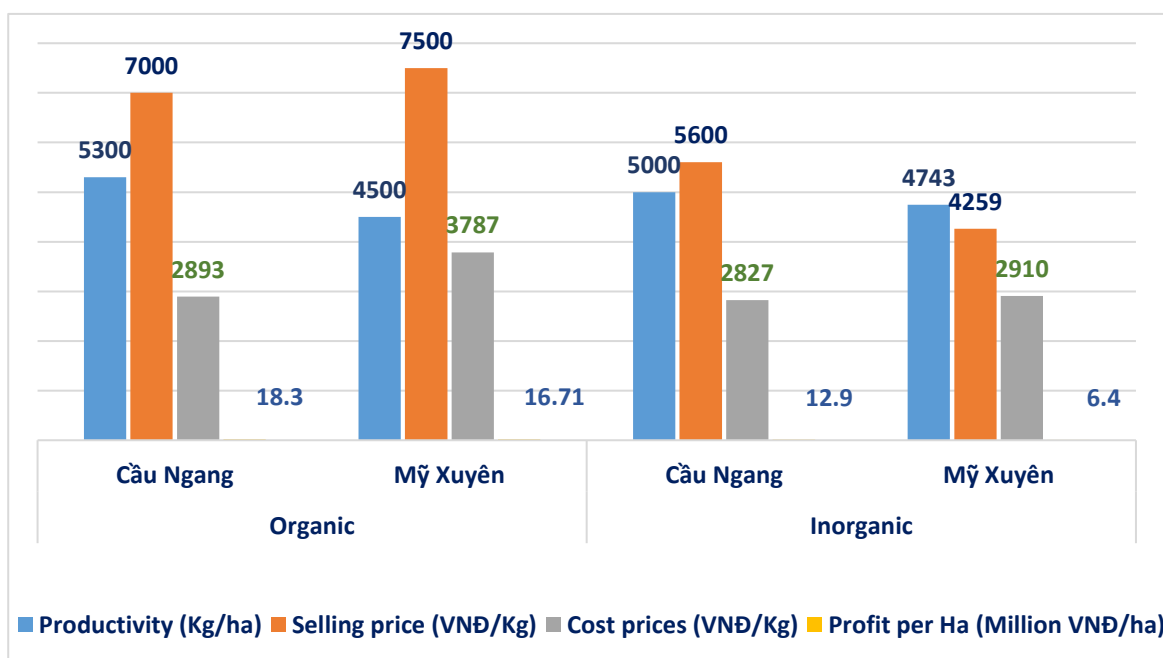
**Figure 2** Model of intercropped organic rice and shrimp farming in An Minh district, Kien Giang province in 2018



## Economic efficiency of organic rice replicated models in Cau Ngang district, Tra Vinh province and My Xuyen district, Soc Trang province in 2017

**Table 2** Economic efficiency of organic rice replicated models in Cau Ngang district, Tra Vinh province and My Xuyen district, Soc Trang province in 2017

Comparative indicators	Cau Ngang district, Tra Vinh province in 2017		My Xuyen district, Soc Trang province in 2017	
	Organic model (ST5)	Inorganic production (ST5)	Organic model (ST 24)	Inorganic production (Local variety)
Total cost (VND / ha)	18,805,000	15,100,000	17,040,000	13,802,000
Productivity (Kg / ha)	5,300	5,000	4,500	4,743
Selling price (VND / Kg)	7,000	5,600	7,500	4,259
Total income (VND / ha)	37,100,000	28,000,000	33,750,000	20,200,000
Profit per Ha (VND / ha)	18,295,000	12,900,000	16,710,000	6,398,000
Cost prices (VND / Kg)	3,548	3,020	3,787	2,910
Profit per kg of rice (VND / kg)	3,452	2,580	3,713	1,349
Capital efficiency	1.00	0.80	1.00	0.5



**Graph 2** Economic efficiency of organic rice replicated models in 2017 in Cau Ngang district, Tra Vinh province and My Xuyen districts, Soc Trang province

In 2017, organic rice models was continued to be replicated in Cau Ngang district (Tra Vinh province) and My Xuyen district (Soc Trang province). The data is presented in Table 2 and Graph 2. In Cau Ngang district, the yield of organic rice model was 5.3 T / ha, while the control (yield of inorganic rice) was 5.0 T / ha. For My Xuyen district, organic rice yield was 4.5 T / ha; while the inorganic

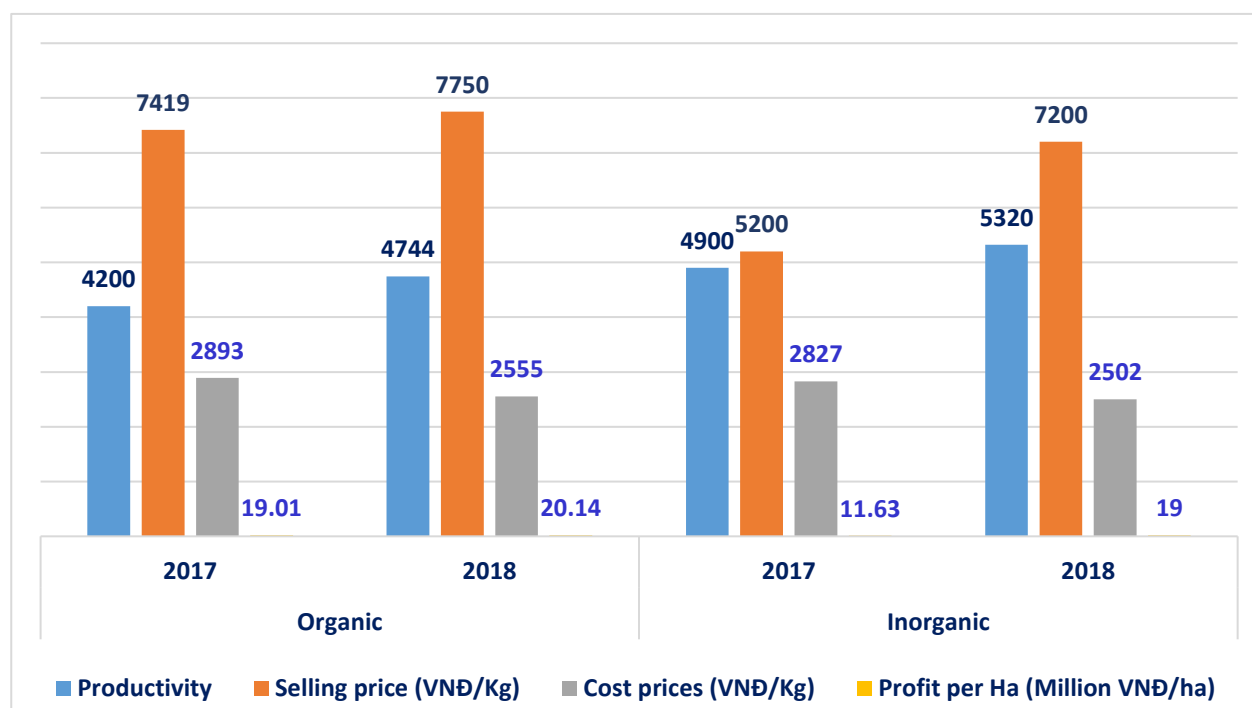
yield was 4,743 T / ha. The selling price of organic rice in Cau Ngang was 7,000 VND / kg; and the selling price of inorganic rice was 5,600 VND / kg. For My Xuyen district, the selling price of organic rice was 7,500 VND / kg, while the selling price of inorganic rice in My Xuyen district was 4,259 VND / kg. The cost prices of organic rice in Cau Ngang were 2,893 VND / kg, while the cost prices of inorganic rice in the same district were 2,827 VND / kg. So the cost prices were equivalent with each other of organic rice and inorganic rice in the same Cau Ngang district.

For My Xuyen district, the cost prices of organic rice (3,787 VND / kg) were higher than the control of 2,910 VND / kg). Regarding to profit per Ha of organic rice in Cau Ngang district was 18,300,000 VND / ha, while inorganic farming was only 12,900,000 VND. While in My Xuyen district, the profit in organic rice farming was 16,710,000 VND / ha but in inorganic rice farming just was only 6,400,000 VND / ha.

### Economic efficiency per hectare of organic rice model in An Minh district, Kien Giang province in 2017 and 2018

**Table 3** Economic efficiency per Ha of organic rice model in An Minh district, Kien Giang province in 2017 and 2018

Comparative indicators	2017		2018	
	Organic model	Inorganic production	Organic model	Inorganic production
Total cost (VND / ha)	12,150,000	13,850,000	12,120,000	13,315,000
Productivity (Kg / ha)	4,200	4,900	4,744	5,320
Selling price (VND / Kg)	7,419	5,200	7,750	7,200
Total income (VND / ha)	31,159,159	25,480,000	24,085,000	23,570,000
Profit per Ha (VND / ha)	19,009,159	11,630,000	20,139,200	19,004,000
Cost prices (VND / Kg)	2,893	2,827	2,555	2,502
Profit per kg of rice (VND / kg)	4,526	2,374	4,245	3,572
Capital efficiency	1.60	0.80	1.70	1.40



**Graph 3** Economic efficiency per Ha of organic rice model in An Minh district, Kien Giang province in 2017 and 2018

In Thanh An cooperative, the enterprises such as Gentraco, LotusRice linked with farmers to implement organic rice certification in 2017 and 2018. The data collected on economic efficiency are presented in Table 3 and Graph 3:

Regarding productivity, in 2017, organic rice model reached 4.2 T / ha; while the traditional production was 4.9 T / ha. In 2018, the yield of organic model rice was 4,744 T / ha, and the traditional rice was 5.32 T / ha. Organic rice yield was still lower than inorganic rice but tended to be increased. There was also a model of organic rice with a higher yield compared to inorganic one as in the case of Long Son commune, Cau Ngang district, Tra Vinh province (2017). This is similar to the study which published on the Rodale Institute, soil under organic management achieved an increase of about 0.025% carbon and 0.01% nitrogen annually, while there were no changes in normal farming conditions. This suggested that, over time, soil in organic farming can provide better nutrition for the needs of organisms and plants [8]. This is also same results in research report by K. Surekha, et al. [10]. They have reported that during the first two years, kharif grain yields in plots with inorganic fertilizers were superior to those with organics by 15-20%. However, during later years, grain yield improved in organics plots to parity with those with inorganics. During rabi, plots with inorganics were superior in grain yield to those with organics for the first four years but both the systems were on par during the fifth year.



**Figure 3** Organic rice model in My Xuyen district, Soc Trang province in 2017

Regarding selling price of organic rice (the purchase price of organic rice of enterprises) in 2017 was 7,419 VND / kg, while inorganic rice price was only 5,200 VND / kg. In 2018, the selling price of organic rice was 7,750 VND / kg, while the selling price of inorganic rice was 7,200 VND / kg.

The cost prices of organic rice in 2017 were 2,893 VND / kg while inorganic rice price of 2,827 VND / kg. The cost prices of organic rice in 2018 was 2,555 VND / kg and the cost prices of inorganic rice this year was 2,502 VND / kg, the difference was not very high.

In terms of profit, in 2017, cultivating by organic method, profit per Ha was 19,010,000 VND / ha compared to the inorganic method, profit was 11,630,000 VND / ha. In 2018, the profit of organic rice production was 20,140,000 VND / ha while inorganic production was 19,000,000 VND / ha. The profit level of organic rice production model in An Minh was not much higher than that of the previous years in other places, but the model was tended to be developed and replicated. This was a remarkable thing.

### Analyzing factors of selling prices and cost prices of organic rice models in different localities from 2015 to 2018

Analyzing factors of selling price and production cost of organic rice models in localities from 2015 to 2018. Data were synthesized and analyzed from 07 models implemented in 07 Autumn-Winter crops (2015-2018) in Chau Thanh district, Tra Vinh provinces (3 crops); Cau Ngang district, Tra Vinh province (01 crop); My Xuyen district, Soc Trang province (01 crop); An Minh district, Kien Giang province (2 crops).

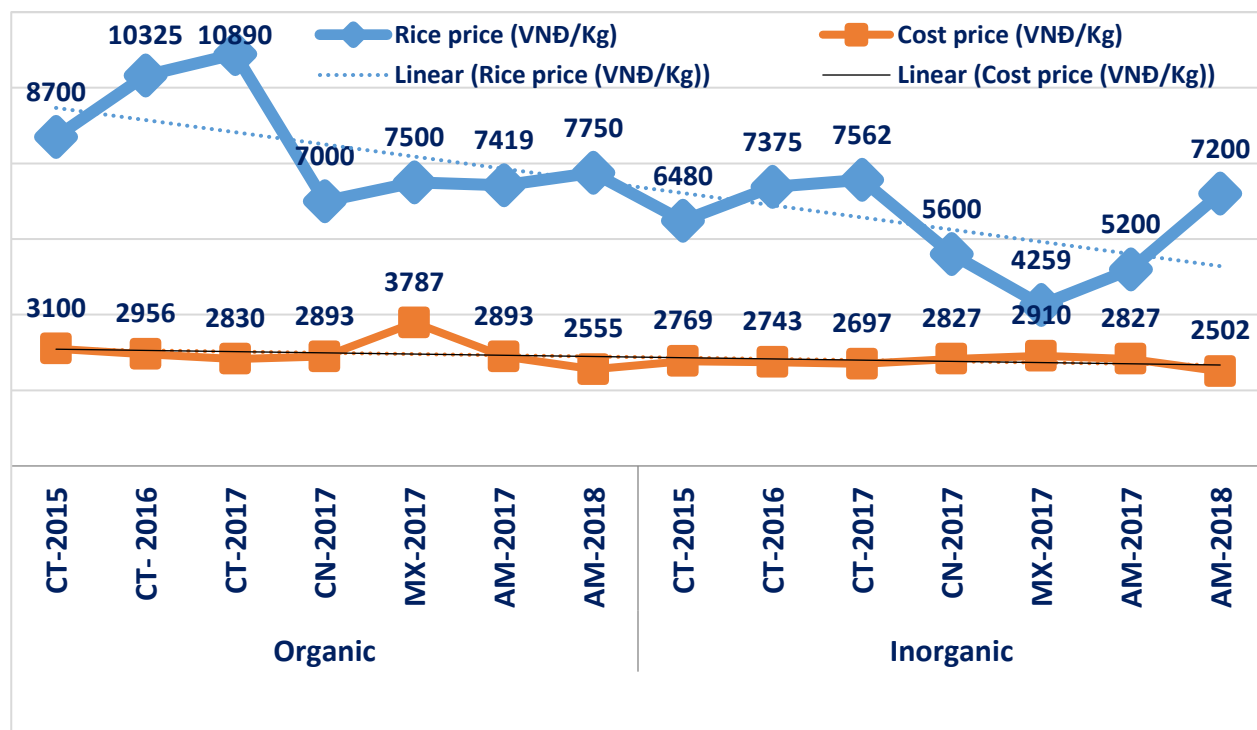
### Regarding selling price of organic rice

In the first 3 years (2015-2017) to implement the project for building a model and a process for organic rice production in Chau Thanh district, Tra Vinh province, because it was the new model, full of difficulties and challenges, farmers were very reluctant to participate. For encouraging farmers to participate the model, the enterprises had built the price which can say very high (in 2015: 8,700 VND / kg) and gradually increase for the following years (in 2016: 10,325 / kg and in 2017: 10,890 VND / kg). Since 2017, the selling price of organic rice has declined markedly. In 2016, organic rice price in Cau Ngang district (Tra Vinh province) was 7,000 VND / kg; in My Xuyen district was 7,500 VND / kg. In An Minh district, price of organic rice was 7,419 VND / kg (2017) and a little



increase of 7,750 VND / kg (2018). Meanwhile, inorganic rice price was fluctuated from 6,480 VND / kg (2015), and increased to 7,200 VND / kg (2018), reaching to the highest level of 7,562 VND / kg (2018) in Chau Thanh district.

The selling price had a positive effect on the profitability of organic rice production. The very higher profit in organic rice production compared to the conventional production due to additional incentive price by enterprises given for the project participants. But profit in recent years was often not high compared to the first years of building the model because the trend of buying price of enterprises (or selling price of organic rice of farmers) tended to be closer to the real value. This helped consumers have opportunity to access and to buy organic rice for domestic consumption instead of just serving for export.



**Graph 4** Trends of selling price and cost prices of organic rice models in the Mekong Delta from 2015 to 2018

**Note:** Location and years of organic rice model production compared to inorganic control

- CT-2015, CT-2016, CT-2017: Chau Thanh district in 2015, 2016 and 2017
- CN-2017: Cau Ngang district in 2017
- MX-2017: My Xuyen district in 2017
- AM-2017, AM-2018: An Minh district in 2017 and 2018

#### For cost prices of organic rice

Statistic data and graphs show relatively stable cost prices of organic rice production from 2015-2018. Cost prices of organic rice at new production model in Chau Thanh district, Tra Vinh province in 2015 was quite high at 3,100 VND / kg, compared to inorganic control of 2,769 VND / kg; The highest cost prices of organic rice production was in My Xuyen district in 2017 with 3,787 VND / kg, compared to inorganic production of 2,910 VND / kg.

The cost prices of organic rice production was lowest in the model in An Minh district in 2018 with only 2,555 VND / kg compared to inorganic production of 2,502 / kg. It is showing that the cost of organic rice production in this place was nearly equal to the cost of inorganic rice production with the same conditions of variety, season and location. This was a remarkable point to earn experiences for the investment in the production of organic rice to reduce costs and increase productivity to increase economic efficiency for farmers and enterprises involved in the value chain linkage.

Under conditions of high production cost, if productivity is lower than inorganic production, farmers' profits will be low. But the productivity will be increased year after year in organic production due to the accumulation of organic matter and nutrients in the soil. This statement is similar to the study of K. Surekha et al. [11], they reported that benefit cost ratio was less with organics in the initial years and improved later over inorganics by fifth year.



**Figure 4** Field workshop of demonstrating suitable harvesting machine for rice-shrimp system in An Minh district, Kien Giang province in 2018

#### 4. CONCLUSION

Organic rice yield was still lower than inorganic rice but tended to be increased. The selling price had a positive effect on the profitability of organic rice production. The very higher profit in organic rice production compared to the conventional production due to additional incentive price by enterprises given for the project participants. But profit in recent years was often not high compared to the first years of building the model because the trend of buying price of enterprises (or selling price of organic rice of farmers) tended to be closer to the real value. This helped consumers have access to buying organic rice for domestic consumption instead of just serving for export.

In the first 3 years, organic prices was very high, in 2015 the price was 8,700 / kg, then increased, in 2016 was 10,325 VND / kg and the highest was in 2017 with 10,890 / kg. After that, it was increased to 12,000 VND / kg. However, this high purchase price had actually made it difficult for enterprises in consuming; they cannot consume products because they cannot compete with similar organic products in other countries. Meanwhile, inorganic rice price ranged from 6480 VND / kg (2015) to 7,200 VND / kg (2018), there was the highest 7,562 VND / kg in 2017 in Chau Thanh district, Tra Vinh province.

The cost prices of organic rice ranged from 2,555 VND / kg to 3,787 VND / kg, while the cost prices of inorganic rice production varied from 2,502 to 2,910 VND / kg. The cost prices of organic rice production was tended to be decreased over time as many reasons such as farmers are familiar with organic farming practices which can find ways to reduce production costs in weeding and fertilizing. This was a remarkable point to earn experiences for the investment in the production of organic rice to reduce costs and increase productivity to increase economic efficiency for farmers and enterprises involved in the value chain linkage.

In terms of profit, it was 24,020,000 VND / ha, 36,480,000 VND / ha and 37,880,000 VND / ha for 2015, 2016 and 2017 respectively. Meanwhile, with the same time and same location, the profit in inorganic farming was 20,590,000 VND / ha, 24,320,000 VND / ha and 25,980,000 VND / ha respectively. However, since 2017, other models only had a profit of 19,010,000 VND / ha (2017) and 20,140,000 VND / ha (2018), compared to 11,630,000 VND / ha (2017) and 19,000,000 VND / ha (2018) in inorganic production. Although the profit of organic rice production for later years had decreased compared to inorganic rice production, the model was still being developed in terms of area, and the number of localities involved. This proved that the spread of models thanks to the participation of State and Government at all levels to enact policies to encourage organic production, especially the investment with social responsibility, community development, safe environment and sustainable production of enterprises. At the same time, it confirms the transformation of farmers' awareness and cultivation behavior towards to sustainable production. There are some areas where farmers are willing to associate with enterprises even though the buying price of organic rice is only a few hundred VND / kg compared to the purchase price of inorganic rice.

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**Conflict of Interest:** The authors declare that there are no conflicts of interests.

**Peer-review:** External peer-review was done through double-blind method.

**Data and materials availability:** All data associated with this study are present in the paper.

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